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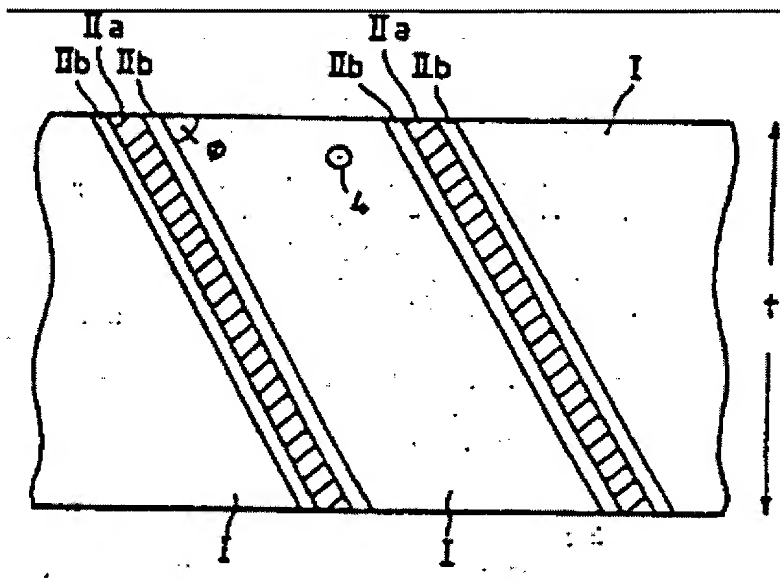
Title: **A Polarizer with only a minor Absorption and a Process for its Preparation, as well as a Light-Source and a Display Device containing this Polarizer**

Abstract

The polarizer according to the invention contains media (I, II) having a different index of refraction. Thereby, the portion of the ordinary light in the incident light-beam will be totally reflected at the interface between the laminated media (I) and (II), while the portion of the extraordinary light will be passed through the medium (II). The medium (II) is arranged at an angle of about 45° relative to the optical axis, and its thickness is selected in such a way, that it will serve as a half-wavelength plate for the transmitted light. Thereby, a polarizer with a high transmittance is obtained due to the reduced absorption, capable of transmitting almost the entire incident light as a polarized light, which is polarized in the same direction.

This polarizer is suited for a bright LCD-device with a large display area.



DESCRIPTION

The present invention deals with a polarizer with a high brightness, as well as with a process of preparation and with applications of this polarizer in a display device and with a polarized light-source.

In a known LCD (= liquid-crystal display) device, a polarization plate with a dichroic light absorption (dichroic polarizers) has been used as a light-polarization element. Thereby, the polarized light is obtained by transmitting only one of the two light-beams polarized in a right angle to each other, while the other light-beam will be absorbed. A non-polarized light reaching the polarization plate from the outside and to be transmitted through the plate, may be split into these two direction of polarization. Since one polarized component will be absorbed in the aforementioned process, more than one-half of the light will be lost. Therefore, the relevant light transmission of the presently generally used polarization plates, is about 40%. The polarization plate is evidently the "bottle neck" in regard to the limited brightness of optical display devices, where a high brightness and light intensity is the desired effect.

For obtaining a display device with a high contrast by increasing the polarization grade (increase of the polarization effect) of the dichroic polarization plate, it is necessary to increase the absorbed portion of the light, whereby the light transmission of polarization plates as presently used in the usual devices for displaying images with a high contrast, will be still further reduced. This tendency to a further reduction is particularly obvious in the case of colored display devices. For increasing the color-saturation grade, it has become mandatory to use a polarization plate with a low light transmittance.

In JP A-61-221728 (1968), an attempt has been described for reducing the losses of light as occurring at reflections, according to which the number of interfaces will be reduced, whereby the polarization plate is used as one of the substrates of a liquid-crystal cell.

Furthermore, in JP A-2-69715 (1990), a process has been proposed for reducing the light losses, whereby the transmitted and reflected light-beams are split by a beam-splitter into rectangularly intersecting polarized light-beams exhibiting the same directions of polarization by means of a half-wavelength plate, and whereby then, the polarized light will be emitted in a parallel direction due to a reflection at a mirror, resulting in an increased polarization grade without an increase of the light absorption.

Insofar as the dichroic polarization plate is presently used in practical applications, the light-loss of the plate may not be decreased, whereby various problems are created.

At an LCD-device of the reflection type, where natural light is utilized, the problem deals with the fact, that a white display is not obtainable, but only a rather grey display is formed due to the losses of light at the polarization plate, even if the display device is designed as a light-intensive and bright display monitor. At an LCD-device of the transmission type with a light-source, the problem deals with the fact, that an increase of the light-density for maintaining a sufficient bright-

ness, will increase the energy input and will generate more heat. In the case of colored display devices, which require color-filters, these problems are still further pronounced.

The process described in JP A-2-69715 (1990) requires the use of optical components, such as a beam-splitter, a reflection mirror, etc. At an enlargement of the device, it is difficult to obtain a large-areal light-source. For instance, it is difficult to use to use this kind of a light-source for the backside illumination of an LCD-device of the size A5. This is true for the type of a device with a direct viewing and also for the reflection type of a device.

The objectives to be achieved by the invention deal with the development of a polarizer with a high optical transmittance, with a large surface area and a small thickness with a reduced dichroic light absorption, which is understood to be the main cause for the light-losses in optical components, such as an LCD-device or the like.

Furthermore, the objectives to be achieved by the invention deal also with the development of a process for preparing a polarizer.

Another objective to be achieved deals with the development of a bright LCD-device.

A fourth objective to be achieved deals with the development of a polarizer and an LCD-device with an improved brightness, but also with an unchanged contrast of the displayed image.

A fifth objective to be achieved deals with the development of a polarization light-source with a polarizer of a high optical transmittance and a large surface area, whereby a polarization plate with a low optical absorption is utilized in the polarizer unit.

Finally, it is also an objective of the invention to develop a display device with a polarization light-source of the aforementioned kind.

In regard to the polarizer, the invention is defined by the characteristic criteria of claim 1, in regard to the LCD-device, by the characteristic criteria of claim 10, in regard to the process for preparing the polarizer, by the characteristic criteria of claim 14, and in regard to the polarization light-source, by the criteria of claim 16, and in regard to the LCD-device fitted with this kind of a polarization light-source, by the criteria of claim 18. Advantageous further developments and forms of execution are the object of the dependent claims.

The following properties have been known as physical phenomena for producing a polarized light-beam from a non-polarized or only partly polarized light:

1. Birefringence;
2. dichroic light absorption;
3. reflection at a dielectric substance.

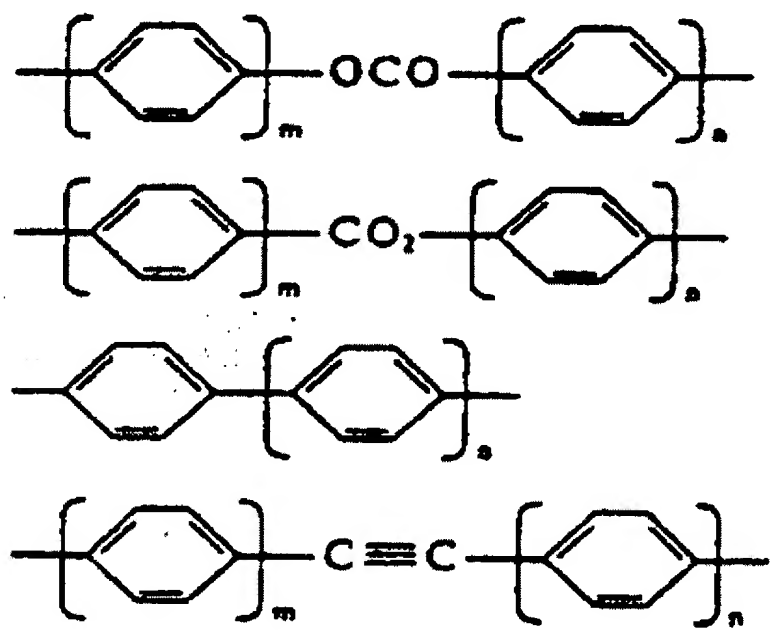
Devices for producing polarized light (i.e. polarizing elements or polarizers) based on each of the aforementioned physical phenomena, have been known.

A birefringent polarizer will permit the emission of a polarized light-beam due to the fact, that the light will be divided in an optical isomeric medium into 2 polarized light-beams. A polar-

izer with a dichroic light absorption will utilize the effect, that only one of the several polarized light beams will be absorbed. A polarizer is presently being used in almost all of the known LCD's.

The light, which is reflected at the surface of a dielectric substance, will be polarized, if the angle of incidence will take on a particular value (Brewster angle). Polarizers, which utilize the aforementioned effects, may be roughly divided into reflecting and transmitting polarizers. The polarizer according to the invention utilizes the phenomenon of the birefringence.

For the medium (I), a crystal with a high birefringence is used, such as e.g. calcite. Oriented organic polymers with a structure according to the following formulas, may also be employed (where *n* and *m* refer to integer numbers with the minimal value of 1):



In regard to the medium (II), which does not necessarily have to exhibit such a high birefringence as the medium (I), films may be used, such as films of polycarbonates, polyester, nylon and the like. However, these films have to show an optical activity. For both media (I) and (II), oriented organic high-polymer films are preferred.

A film structure with the media (I) and (II) will be obtained by laminating and combining the media with each other in an alternating manner, whereby a multilayered structure is produced as yet to be further described below. For forming the desired film structure, the layers are cut under a given angle of inclination. For bonding the media (I) and (II) to each other, the medium (II) is advantageously coated with an adhesive layer exhibiting a defined refractive index.

In the following, the invention and the advantages and effects of the invention shall be further explained by describing execution examples as illustrated in the attached drawings:

Fig. 1 illustrates a schematic cross-section through a polarizer according to the invention.

Fig. 2 illustrates a schematic perspective view of the polarizer shown in fig. 1.

Fig. 3a and b show cross-sections for explaining the functioning of the polarizer according to the invention.

Fig. 4 shows a cross-section for explaining another polarizer according to the invention.

Fig. 5 illustrates a schematic cross-section through an LCD-device according to the invention of the reflection type.

Fig. 6 illustrates a schematic cross-section through an LCD-device according to the invention of the transmission type.

Fig. 7 illustrates a schematic cross-section through another polarizer according to the invention.

Fig. 8 illustrates a schematic cross-section through another LCD-device according to the invention of the reflection type.

Fig. 9 illustrates a schematic cross-section through another LCD-device according to the invention of the transmission type.

Fig. 10 illustrates a schematic perspective view of an LCD-device according to the invention with a driver circuit.

Fig. 11a and b are drawings for explaining a process of preparation for preparing a polarizer according to the invention.

Fig. 12 illustrates a schematic partial cross-section through a polarizing light-source.

Fig. 13 illustrates a schematic perspective view of the polarizing light-source shown in fig. 12.

Fig. 14 illustrates a schematic view of an overhead projector with a polarizing light-source according to the invention.

Fig. 15 illustrates a schematic view of a liquid-crystal projector with a polarizing light-source according to the invention.

At first, the invention shall be further explained by referring to fig. 3. A structure consists of the media (I) and (II), which are both optically active. These media are laminated onto each other and the plane of lamination is inclined (by an angle Φ) relatively towards a surface line (AA') of the polarizer. Now, the case shall be described, where the light will reach the surface plane (AA') of the polarizer under an almost right angle.

This light will traverse the medium (I) and will reach the interface at the medium (II). If the angle of inclination (Φ) at the interface is sufficiently large and the refractive index n_{II} is sufficiently small in comparison to the refractive index n_I of the medium (I), the light will be totally re-

flected at the inclined interface, as illustrated in fig. 3a. The reflected light advances in the forward direction and will reach the interface of the medium (II'), where the light will again be totally reflected. Then, the light will traverse the surface (BB') and will be emitted.

The conditions for the total reflection is defined in this case by the following equation:

$$\Phi > \sin^{-1} (n_{II} / n_I) \qquad (1)$$

At the other hand, if n_{II} is larger than n_I or if the difference is so small, that the conditions for a total reflection will not be met, the light will be passed from the medium(I) into the medium (II), as illustrated in fig. 3b, whereby the light will traverse the medium (I') and will be emitted.

If a birefringent material is used as the medium (I), where only one refractive index will meet the conditions for a total reflection and if assumed, that the medium (II) exhibits an optical activity (in this case, the term "optical activity" is to mean a property, whereby during the input and throughput of polarized light, a polarized component will be produced with an optical axis, which is rectangularly or crosswise aligned relative to the incident polarized light), the polarized light component in the light reaching the polarizer, which is totally reflected (fig. 3a), will be emitted without a change in the direction of the polarization. At the other hand, the traversed component of the polarized light (fig. 3b) will be emitted with a change in the direction of the polarization. This means, that the light will be emitted to the outside in the same direction of polarization as the totally reflected and emitted polarized light. Therefore, by means of the described process, the polarization grade of the polarized light may be increased without experiencing a reduction of the light intensity due to an absorption.

For assuring that the one of the two polarized light-beams, which intersect each other in a right angle, will be totally reflected, while the other light-beam will be transmitted through the media as a polarized light, the conditions of the following equation have to be met:

$$\sin^{-1} (n_{II} / n_{I1}) < \Phi < \sin^{-1} (n_{II} / n_{I2}) \qquad (1)$$

where n_{I1} and n_{I2} mean the maximum or the minimum, respectively, of the refraction indices of the medium (I) and n_{I1} is larger than n_{I2} and n_{II} means the refractive index of the medium (II) near the interface of the lamination layer.

As seen from the equation (1), the admissible range for the angle of inclination will become the larger and the limitations on the changes in the structure of the polarizer will be further extended, the larger the birefringence $\Delta = (n_{I1} - n_{I2})$ of the medium (I) is. At the same time, the angle of visibility will be widened.

In the foregoing, the effect of the light has been described, which enters into the medium (I). However, this effect is not true for the light directly entering into the medium (II). At the other hand, if the medium (I) has a sufficient thickness in comparison to the medium (II), almost the entire amount of the incident light may be utilized in the described manner, highlighting the advantages of the present invention.

As further clearly recognized from the schematic drawing in fig. 4, both kinds of light, i.e. the kind of light directly reaching and entering the medium (II), as well as also the kind of light di-

rected into the medium (II) after having entered at first the medium (I), to be repeatedly reflected (or traversed) at the interfaces between the media (I) and (II), if the thickness (distance p) of the medium (I), as well as also of the medium (II) is sufficiently thin in comparison to the thickness (t) of the polarizer. By increasing the number of events, at which the light will reach the interfaces between the media (I) and (II) in the aforementioned manner, the polarization grade will be increased.

The foregoing explanation refers to the case, where the light will reach the polarizer under a right angle. However, the same effect will be achieved, if the incident light will reach the polarizer under an oblique angle, as long as the conditions for the total reflection and transmission as illustrated in fig. 3, will be met. For instance, in the case of an LCD-device, where the light-source as well as also the LCD-panel have a large surface area to be viewed under an oblique angle, the display will have a sufficient contrast, if the conditions for the total reflection and transmission as illustrated in fig. 3, will be met.

In the following, the invention shall be further explained by describing some concrete execution examples.

Execution Example 1

A polarizer with a high optical transmission is illustrated in the fig. 1, 2 and 3 as the first execution example of the invention. In fig. 1, a part of a schematic sideview of a plate-shaped polarizer is shown. In fig. 2, a schematic perspective view of the polarizer is illustrated and in fig. 3, a schematic cross-section through an enlarged polarizer is illustrated.

The polarizer is composed of the media (I) and (II), which exhibit different optical properties and are laminated to each other with obliquely inclined interfaces. The medium (I) consists of calcite, which is polished for optical purposes. The optical axis of the medium (I) is rectangularly aligned relative to the paper surface. The refractive index of the medium (I) for the extraordinary light is $n_{I1} = 1.486$, while the refractive index for the ordinary light is $n_{I2} = 1.658$. The medium (II) consists of a lengthwise stretched polycarbonate film and of an adhesive layer (Canada balsam). The refractive indices of the polycarbonate for the extraordinary and the ordinary light, respectively, are $n_{II1} = 1.590$ and $n_{II2} = 1.585$, respectively. The refractive index of the adhesive is $n_{III1} = 1.550$, whereby all these refractive indices are smaller than the refractive index n_{I2} of the medium (I). The angle of incidence is 75° and the thickness of the polarizer is 10 mm. As the light-source, a plane light-source of rod-shaped fluorescent light-tubes and photo-conductors of an acrylic resin are used.

As illustrated in fig. 3, the light will reach the outside surface (AA') of the polarizer in a right angle, thereby forming an angle of incidence (Φ) at the interface between the media (I) and (II). Since the ordinary light (but not the extraordinary light) will in this case meet the conditions for a total reflection, the ordinary light will be totally reflected (fig. 3a) and only the extraordinary light will penetrate into the medium (II) (fig. 3b). As seen, the polycarbonate film is arranged as the medium (II) in such a way, that the optical axis is aligned to about 45° relative to the plane of the paper.

The thickness is selected in such a way, that the plate may serve as a half-wavelength plate for the incident and the transmitted light. This means, that the phase difference (dΔn) is selected in such a way, that it will correspond to a path-length of 0.275 μm while traversing the medium (II) (d is the length of the optical path). Accordingly, the direction of the polarization will be turned by about 90° during the traversing of the medium (II). At the described execution example, an inorganic crystal (calcite) was used as the medium (I). However, in principle, it is irrelevant, whether the medium (I) is organic or inorganic, as long as the substance exhibits the optical properties, by which the effect of the invention will be realized. In the same way as mentioned for the medium (II), a lengthwise stretched high-polymer film may also be employed for the medium (I).

The thickness of the polarizer of 10 mm is substantially thicker than the thickness of conventional dichroic polarization plates, which have a maximal thickness of 1 mm. However, it is also possible to prepare the polarizer as a thin plate, where several very thin stretched high-polymer films, etc., will be laminated.

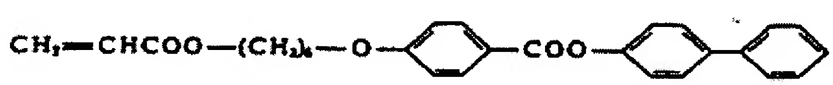
In fig. 1, a flat plane polarizer is illustrated. However, the polarizer does not have necessarily to be flat, but depending on the particular application, may have a bent or spherical surface shape.

Execution Example 2

Another execution example for achieving the objectives of the invention, is illustrated in fig. 4.

In comparison to the execution example 1, the ratio (p/t) of the distance (p) of the media to the thickness (t) of the polarizer, is remarkably small (< 1). It is t = 5 mm and p = 0.5 mm.

In this case, the material for the medium (I) consists of a highly polymeric liquid-crystal prepared by a UV-initiated polymerization of a liquid-crystal compound of the following structure:



The process for orienting the highly polymeric substances, includes the following process steps:

- Placing the liquid-crystalline compound between glass-substrates, which had to be polished;
- Heating to 80°C to transfer the compound into the nematic liquid-crystalline phase;
- Solidification of the compound by means of a photo-polymerization by applying a UV-radiation, while maintaining the temperature of 80°C; and
- Examination of the uniformly oriented film.

Subsequently, the films were peeled from the glass-substrates and laminated. The refractive indices of the obtained films were 1.72 for the extraordinary light and 1.49 for the ordinary light.

In regard to the medium (II) and the adhesive, the same materials were used as described in the execution example 1. The angle of inclination (Φ) at the interface of the adhesive, was 70°.

The polarizers according to the execution examples 1 and 2 exhibit a brightness (light intensity), which is about 1.5-times more intense than observed with conventional polarizers.

Execution Example 3

Now, an execution example of a device for a bright liquid-crystal display unit shall be described as another object of the invention.

In fig. 5, an execution example of a device for a liquid-crystal display unit of the reflective type is schematically illustrated. The light (11) will reach at first a polarizer according to the invention and will be converted during the passage into a polarized light with an increased polarization grade, while only negligibly weakened by an absorption, and the light will subsequently reach the liquid-crystal panel (8) and, then, be reflected by a reflection plate (9). The reflected light (12) is directed backwards and will, finally, be emitted.

In fig. 6, an execution example of a device for a liquid-crystal display unit of the transmission type is schematically illustrated. The polarizer is arranged between the light-source (14) and the liquid-crystal panel (8). The light (16) emitted from the light-source is at first reflected in a light-conductor (15) in such a way, that it will reach the polarizer (7) and it will be converted during the passage into a polarized light with an increased polarization grade and a strongly reduced absorption loss in the same way as with the device for the liquid-crystal display unit of a reflective type. Subsequently, the light will reach the liquid-crystal panel (8).

If a polarizer (7) is used as described in the first execution example, the energy of the light-source may be reduced by 30% for producing the same brightness of the display as obtained by using a conventional polarizer.

Execution Example 4

Now, the execution example of a polarizer shall be described, additionally exhibiting not only an increased brightness, but also an increased contrast. This will be the 4th. example of the invention.

As schematically shown in fig. 7, a dichroic polarization plate (13) is laminated together with a polarizer (7) according to the first execution example. The polarization axis (19) of the light having traversed through the polarizer (7) and the transmission axis (17) of the dichroic polarization plate (13) are aligned in parallel. The dichroic polarization plate (13) is arranged opposite to the light-source, regardless whether or not natural light is utilized from the outside or an attached light-source is utilized.

In fig. 8 and 9, an LCD-device of the reflective type and of the transmission type, respectively, are schematically illustrated. These LCD-devices utilize a polarizer (7)according to the first execution example, which is combined with a dichroic polarization plate (13). A schematic perspective illustration of an LCD-device with a driver circuit is shown in fig. 10.

A liquid-crystal cell is composed of a liquid-crystal (10) mounted between the transparent substrates (29) and (29'), each fitted with transparent electrodes (27) and (27'), respectively. At the outside of the liquid-crystal cell, the polarizer according to the invention and the dichroic polarization plate (13) are arranged. The transparent electrodes (27) and (27') will be addressed by the driver circuits (28) and (28'), respectively, and be scanned according to a pattern to be displayed. The liquid-crystal will be affected by a potential to be applied to the liquid-crystal. The actual display occurs by means of light, which is applied to the backside of the polarizer (7).

As LCD-types, the Super-TN-type and the TFT-type are well known, as well as the type with a liquid-crystal with a high dielectric constant, and also the superhomeotropic type. However, the present invention is applicable to all types, in which a polarizer is used.

From the light of a light-source, only very small amounts will be lost, if the polarizer according to the invention is utilized. Therefore, the light-source may e.g. be utilized as the lighting devices for the headlamps of automobiles. If the headlamps are e.g. fitted with a polarization direction turned to the right by 45°, and the driver wears polarized eye-glasses (with a dichroic light absorption), which is only transparent for a polarized light with the same direction of polarization. Therefore, the perceived amount of light from an oncoming automobile, will be substantially reduced, which means an increased safety factor. The same effect will be achieved, if a dichroic polarizing film with the same direction of polarization as otherwise used on the polarized eye-glasses, is attached to the windshield of the motor-vehicle.

The same effect is also achieved, if a dichroic polarizing film is attached at the rear window or the sideview mirrors. In particular, if motor-vehicles following or passing each other in the

traffic are fitted with headlamps of the same type, the undesired blinding may essentially be eliminated, whereby the directions of polarization are aligned to the right or left, respectively, by 45°.

The polarizer according to the invention may not only be used for an LCD-device, but also e.g. as an optical acceptor for a polarization detector.

Execution Example 5

A process of preparation for preparing a polarizer according to the invention shall be described in this example.

The medium (I) and the medium (II) are laminated onto each other and wound into a roll as illustrated in fig. 11a. The laminated layers are bonded to each other and the adhesive bond is cured for forming the laminated cylindrical roll (2) as illustrated in fig. 11b.

Subsequently, the cylindrical roll is sliced along the cutting planes (30,30'), which are selected in such a way, that they will form a predefined angle (Φ) at the interface between the media (I) and (II). Thereby, the slicing process is to be carried out in such a way, that the shear-force coincides with the direction of the optical axis (4). In this manner, a deformation of the optical axis by the applied shear-forces may essentially be avoided.

If this kind of a polarizer is used at an LCD-device, an increased brightness of the displayed image will be achieved.

Execution Example 6

In fig. 12 and 13, a sixth execution example of the invention is illustrated, showing a polarized light-source with a high efficiency grade by using a polarizer with a high light-transmission. The polarized light-source is equipped with a light-source emitting non-polarized light or weakly polarized light, as well as with a polarizer for increasing the polarization grade.

Execution Example 7

In fig. 14, an example of an overhead projector is illustrated utilizing a polarization light-source according to the invention. This polarization light-source (10) is mounted in the lower part of the projector housing. The light is passed through a liquid-crystal panel (11), a magnifying lens (12), is reflected at a reflection mirror (13) and is projected onto a screen (14). In comparison to a conventional projector with the same brightness (light-intensity), the energy consumption is reduced by 30%.

Depending on the application case, the projection may also be carried out differently, whereby e.g. the polarization light-source is arranged in the upper part of the projector and a liquid-crystal panel is radiated by the polarized light, whereby this liquid-crystal panel is arranged beneath the polarization light-source. After having passed through the liquid-crystal panel, the light is projected to the screen by means of the magnifying lens (12) and the reflection mirror (13).

In fig. 15, a liquid-crystal projector is illustrated, where the same polarization light-source according to the invention is utilized as also used in the overhead projector. In this case, too, 30% of the energy for the light-source will be saved in the same way as described before in reference to the overhead projector in comparison to the use of a conventional liquid-crystal projector.

The polarization light-source according to the invention exhibits a high light-transmission for the original light. Therefore, if operating at the same brightness (light intensity) as used with conventional light-sources, the energy consumption may be substantially reduced, which means also an advantageous increase of the useful life of the light-source.

PATENT CLAIMS

1. An only little absorbing polarizer, **wherein**
   - a medium (I) is employed, which is birefringent for producing a light with 2 or 3 polarization modes with a different refraction; and
   - a medium (II) is employed, which is optically active and has a surface or a surface layer with a refractive index, which is less than the largest refractive index among the 2 or 3 refractive indices of the medium (I);
   - the two media (I) and (II) are alternately laminated onto each other for forming a plurality of layers; and
   - whereby the interfaces of the laminated layers are aligned under such an angle (Φ), that a portion of the light having entered into the medium (I) and having formed one of the polarization modes, will be totally reflected at the interface between the media (I) and (II), while the light of the other polarization modes will essentially traverse the medium (II) without restriction.

2. A polarizer according to claim 1, **wherein** the angle of inclination (Φ) between the direction of incidence of the light into the medium (I) and the interfaces of the laminated layers, has to meet the conditions of the following equation (1):

   $$\sin^{-1}\ (n_{II}/n_{I1}) < \Phi < \sin^{-1}\ (n_{II}/n_{I2}) \qquad (1)$$

   whereby n_{I1} and n_{I2} refer to the maximal or minimal refractive index of the medium (I) and $n_{I1} > n_{I2}$ and
   n_{II} refers to the refractive index of the medium (II) near the interface of the laminated layers.

3. A polarizer according to one of the claims 1 or 2, **wherein** the medium (II) is comprised of a layer (IIa) with a given refractive index and an optical activity, and of an adhesive layer (IIb) with a given refractive index and an adhesive strength.

4. A polarizer according to one of the claims 1 to 3, **wherein** the layer of the medium (I) is thicker than the layer of the medium (II).

5. A polarizer according to one of the claims 1 to 4, **wherein** the medium (I) and/or the medium (II) is formed from layers of oriented organic high-polymers.

6. A polarizer according to one of the claims 1 to 4, **wherein** the medium (I) is formed from a liquid-crystalline high-polymer film.

7. A polarizer according to one of the claims 1 to 6, **wherein** the polarizer is provided with a dichroic polarization plate (13) with an optical transmission axis arranged in such a way, that the axis is essentially aligned in parallel to the polarization direction of the light emitted from the polarizer.

8. An only little absorbing polarizer, **wherein** the polarizer is composed of the following components and will function as follows:
   - at least 2 media (I,II) which are laminated onto each other;

- at least one of the media (I) is birefringent;
- at least the other medium (II) is optically active;
- non-polarized or only little polarized light entering from the outside, will be divided into 2 or 3 polarized light-beams;
- light of at least one polarization direction is emitted via the optically active medium without a transmission;
- light of at least one polarization direction is emitted via the optically active medium after a transmission and
- light of the two polarization directions will be synthesized.

9. A polarizer according to one of the claims 1 to 8, **wherein** the interfaces of the laminated layers are arranged under such an angle, that the light of the one direction of polarization, which traverses the medium (I), will be reflected at the interface between the media (I) and (II), while the light of another direction of polarization will traverse the medium (II), and whereby the film thickness of the medium (I) is selected in such a way, that the reflected light will be reflected several times during its passage through the polarizer.

10. An LCD- (= liquid-crystal display) device with
    - a conductive film;
    - a pair of substrates, from which at least one substrate is transparent;
    - a liquid-crystal panel (8) with a liquid-crystal layer arranged between the substrate pair;
    - a polarization device (7) for the light, which will reach the liquid-crystal panel; and
    - a driver circuit (28,28') for driving the liquid-crystal layer by feeding an electric potential into the conductive film,

    wherein the polarization device is a polarizer according to one of the claims 1 to 9.

11. An LCD-device according to claim 10, **wherein** the polarization device (7) and an optical reflector (9) are arranged at both sides of the liquid-crystal panel (8).

12. An LCD-device according to claim 10, **wherein** a dichroic polarization plate (13) is laminated onto the polarization device (7) and the last mentioned device is arranged in such a way, that the dichroic polarization plate will be positioned opposite to the liquid-crystal panel (8).

13. An LCD-device according to one of the claims 10 or 11, **wherein** a dichroic polarization plate (13) is laminated onto the polarization device (7) and the polarization device and an optical reflector are arranged to both sides of the liquid-crystal panel (8).

14. A process for preparing a polarizer, **wherein** the process is characterized by the following process steps:
    - Preparation of a laminated structure by an alternating laminating and bonding of the two media (I) and (II) to each other, whereby the medium (I) exhibits a birefringence for producing 2 or 3 polarization modes due to the different refractive indices, and whereby the medium (II) exhibits an optical activity, has a given thickness and a surface or a surface layer with a refractive index, which is less than the largest refractive index of the 2 or 3 refractive indices of the medium (I);
    - cutting off slices with a given thickness from the laminated rolls under an angle, which is predefined in such a manner, that the interfaces of the laminate structure will form a particular angle, whereby the polarized light of the one mode, which traverses through the me-

dium (I), will be reflected at the interface between the media (I) and (II), and the light of the other polarization mode will essentially pass through the medium (II) without restriction;

- preparation of a film, in which the media (I) and (II) are arranged in a stripe-like pattern.

15. A process according to claim 14, **wherein** oriented organic high-polymers are used for preparing the media (I) and (II), which are subsequently combined and bonded together.

16. A polarization light-source with:
    - a light-source (2) producing no or only a little polarized light; and
    - a polarizer (1), which receives this light and emits a highly polarized light,

    wherein the polarizer is a polarizer according to one of the claims 1 to 7.

17. A polarization light-source with:
    - a light-source (2) producing no or only a little polarized light; and
    - a polarizer (1), which receives this light and emits a highly polarized light,

    wherein the polarizer is a polarizer according to claim 8.

18. A display device with:
    - a polarization light-source (10) and
    - a device for focusing an image produced by an LCD-device and projected onto a projection screen (14),

    wherein

    - the polarization light-source is a light-source according to claim 16 and
    - the device for focusing the image will function in such a way, that the device will collect the polarized light emitted from the polarization light-source and will direct the light through the LCD-device.

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8 Pages with drawings are attached.

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